



OPERATING EXPERIENCE SUMMARY

Issue Number 2006-10, Article 2: Failure to Follow Procedures Results in Potential Overexposure During Radiography

Failure to Follow Procedures Results in Potential Overexposure During Radiography

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On June 6, 2006, at a non-DOE facility in Louisiana, two radiographers received an effective radiation dose in excess of the Nuclear Regulatory Commission (NRC) annual occupational limit of 5 rem. The radiographers were handling a radiographic device (camera) and believed that the 41-curie, iridium-192 (Ir-192) source was properly stowed in the shielded position when it was not. Neither radiographer had a radiation survey instrument with them that would have warned them of the exposed source. (NRC Event Report 42619; WSRC Lessons Learned 2006-LL-0039)

A radiographer and his assistant were using the camera to perform multiple radiography exposures. After the 19th exposure, they noticed that the source assembly appeared to have slightly more resistance when exposing and returning the source to the shielded position. They performed the final exposure and again noticed resistance as the crank handle was rotated to the shielded position and the lock plunger came up to the locked position. The radiographers did not perform any radiation surveys to verify safe conditions, as required. After experiencing some difficulty disconnecting the source tube from the control assembly, the radiographer and assistant carried the radiographic equipment to their truck and drove to their shop. After eating lunch, the radiographers unloaded the camera and realized that the source pigtail (Figure 2-1) was not in the camera.



Figure 2-1. Typical radioactive source pigtail

The calculated worst-case dose was 13 rem for the radiographer and 14.5 rem for the assistant. Analysis of the radiographers' thermoluminescent dosimeters (TLDs) revealed a monthly dose of 1.1 rem and 2.2 rem, respectively. The radiographers' employer is performing cytogenetic analysis on blood samples taken from both of the radiographers.

Investigators determined that neither the radiographer nor the assistant used a radiation survey instrument to determine the source position, nor did they turn on their required alarming rate meters. The direct reading dosimeters for both of the workers were determined to be off-scale. The State of Louisiana is conducting a reactive inspection to review the employer's analysis and determine the root cause of the event.

Radiography equipment typically uses 30- to 100-curie Ir-192 or cobalt-60 sources. The source is contained in a small metal capsule at the end of a short flexible cable (pigtail). The other end of the pigtail is attached to a long cable that is cranked out by the radiographer to ensure a safe distance is maintained from the source. The source is positioned near one side of the object being radiographed while the film is placed on the other side and exposed for only a few seconds.

A review of the NRC event notification database showed 18 reported events involving radiography so far in 2006 (Figure 2-2). Almost half of these events resulted in personnel exposures, followed closely by events involving radiographic equipment malfunctions.



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Common causes of personnel exposures include the following:

- Believing the source was safely retracted without verification;
- Approaching the camera without survey meter and with an unshielded source; and
- Picking up a guide tube while it contained the source.

Typical equipment malfunctions include the following:

- Crank cable housing came loose while moving the device;
- Source stuck in extended position and failed to retract;
- Disconnected source pigtail; and
- Crimped source tube.

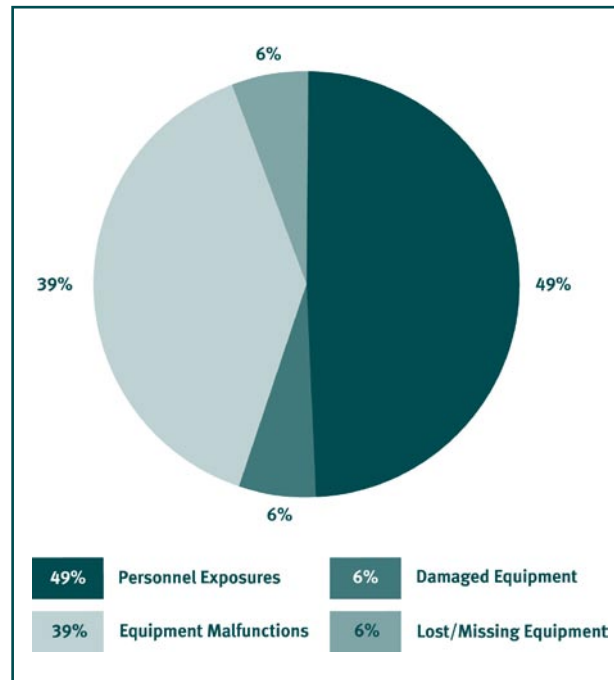


Figure 2-2. NRC-reported radiography events (2006)

Accidents involving the use of radiographic equipment can result in extremely high radiation exposures. For example, on March 3, 2006, at a fixed radiography facility in Rhode Island, a radiographer trainee picked up a guide tube containing a 93-curie Ir-192 source.

The Rhode Island Department of Health Radiation Control estimated the dose at 8 rem whole body and 18,000 rem to the hand. The trainee was taken to an emergency room.

(NRC Event Report 42384)

In March of 1999, the NRC issued Information Notice 99-04, *Unplanned Radiation Exposures to Radiographers, Resulting from Failures to Follow Proper Radiation Safety Procedures*. The information notice was a reminder to the nuclear industry of the risks of unplanned high radiation exposures from radiographic equipment and the need to follow radiation safety procedures. The notice was prompted by a series of incidents that resulted in unplanned radiation exposures. ([NRC Information Notice 99-04](#))

Radiography events at DOE facilities are few in number and result primarily when personnel violate the radiography exclusion areas. These violations resulted from failure to properly post the areas, failure to notify personnel of radiographic operations, failure to activate warning lights, and failure to obey postings. Title 10 of the Code of Federal Regulations, Part 835, *Occupational Radiation Protection*, specifies regulatory requirements for personnel protection such as sealed source control, posting and labeling, training, and entry control.

These events highlight the importance of strict adherence to radiological safety procedures. Many industry overexposures occur because personnel fail to use radiation survey instruments or wear alarming dosimeters when approaching the equipment. Paragraph 34.49, Radiation Surveys, of 10 CFR 34 requires that radiographers conduct a survey of the radiographic exposure device and the guide tube after each exposure when approaching the device or the guide tube. The survey must determine that the sealed source has returned to its shielded position before exchanging films, repositioning the



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GUIDANCE FOR RADIATION GENERATING DEVICES

DOE-STD-1098-99, *Radiological Control*, section 365, “Radiation Generating Devices,” provides control requirements for radiographic devices and identifies provisions for applicable types of radiation-generating devices that should be included in site-specific procedures.

10 CFR 34, *Licenses for Radiography and Radiation Safety Requirements for Radiographic Operations*, provides requirements for onsite operation with devices containing sealed sources for radiographic use.

ANSI N43.3, *American National Standard for General Radiation Safety-Installations Using Non-Medical X-Ray and Sealed Gamma-Ray Sources, Energies up to 10 MeV*, establishes acceptable guidelines for onsite operations with devices other than sealed sources for radiographic use.

DOE G 441.1-5, *Radiation-Generating Devices Guide*, provides an acceptable methodology for establishing and operating a control program for radiation-generating devices.

DOE G 441.1-13, *Sealed Radioactive Source Accountability and Control Guide*, provides an acceptable methodology for establishing and operating a sealed radioactive source accountability and control program.

exposure head, or dismantling the equipment. Facility managers should ensure that workers understand their responsibility for procedure compliance.

KEYWORDS: *Radiation exposures, radiography, stop work, radiation control procedures, radiation generating device, camera, source*

ISM CORE FUNCTIONS: *Analyze the Hazards, Develop and Implement Hazard Controls, Perform Work within Controls*